HAZARDS OF GRAIN ELEVATORS

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The hazards of grain
elevators

The Hazards of Grain Elevators

A THESIS

PRESENTED BY

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OBJECT. The enormous values represented by grain elevators, and the fact that fires originating in them usually travel with such great rapidity and intensity makes the problem of the prevention of fires in them a serious one. From the experience tables of ten Mutual Fire Insurance Companies writing grain elevator insurance, they have had in four years, losses amounting to $2,565,000.

The object of this thesis is to investigate grain elevators, to ascertain their hazards and to determine a means for their protettion.

We gratefully acknowledge our indebtedness to Mr. A. T. Wenner for his many valuable suggestions and, to Professor Joseph B. Finnegan.

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The Hazards of Grain Elevators.

PART I.

CONSTRUCTION. There are three general classes of grain elevators: those used for storage of grain, those used for cleaning the grain and a combination of the two, cleaning and storage. The first type to be used in general practice was the "cribbed" wood-elevator. These are built of wood piles driven into the ground or on a stone foundation. The walls are built up of 2x12" planks, one above the other and fastened by spikes. They carry no load and are anchored to the bins. The bin walls are constructed in the same manner as the outer walls except of lighter material. The bins rest on heavy wooden beams, and are carried on heavy columns. The bins are from 50 to 75 feet in height. At the bottom of each bin is

a hopper connected to a conveyor. A cupola is built at the top, and is carried on 2x8" studs. The garners, conveyors and scales are placed in the cupola. Often the outer walls of these elevators are covered with a corrugated steel. These structures have been displaced to a great extent by the fire resistive type now used in or about the larger cities due to the durability of building elevators of fire resistive materials. Most of the elevators however, in use along railroad lines in the country districts still are of wood construction.

The three materials used in fire resistive elevator construction today are, brick, tile and concrete. Concrete is probably in greater use than either of the other two. Brick is an excellent material both for its strength and fire-resistive qualities but,

its cost exceeds that of either tile or concrete. Tile to is very desirable but, as compared with concrete, its chief disadvantage is its porosity, and it becomes necessary to paint the tile from time to time in order to keep out the moisture. Concrete due to its absorption of carbon dioxide from the air becomes denser and stronger with time, and its maintenance cost is small. The fire resistive qualities of concrete properly mixed, are well known and its porosity is small, thus making an ideal substance for grain elevator construction.

These types of grain elevators are built of rectangular form with high walls upon which is mounted a cupola. They are usually divided into four stories and basement. In the basement are the elevator boots, the conveyors, the shafting necessary for the operation of them, receiving hoppers and car-pullers.

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On the first floor called the receiving floor, is all the machinery used for cleaning and clipping the grain. Next, are the bins which are usually about 150' in height. Above the bins is the bin floor having openings into all the bins. Spouts from the floor above called the scale floor lead into the bins. These spouts are so arranged that any desired bin can be filled directly from the scales. On the scale floor are all the scales for weighing the grain. Above the scales are the large bins called garners, and above the garners in the cupola are all the elevator heads. Within the last few years large storage tanks have been built in conjunction with the elevator proper. These tanks are located away from the building, and are connected by conveyors above and below for filling or emptying them. They are cylindrical in form and are

built of brick or concrete.

The first tanks to be built of fire-resistive material were made of steel. This, however, proved to be unsatisfactory, because steel is a good conductor of heat, and in several instances where the tanks were exposed to fire not of sufficient intensity to destroy them, the contents were badly burned.

The boiler-house is built away from the elevator proper and contains the boilers, engines, etc.

PROCESSES: A grain elevator receives grain from railroads or vessels according to its location. The grain is unloaded from the cars or vessels into hoppers from which it is carried by means of conveyors to the elevator boot whence it is raised in buckets attached to a belt into the elevator head at the cupola where it is dumped into the garners. It is then weighed by the scales under the garners after

which it is spouted into the bins or storage tanks. When needed it is drawn from the bins or tanks by hoppers, and carried by conveyors to the cleaners or clippers, whence it is spouted into the cars or vessels.

The cleaning machines consist of a series of large screens which have a rapid backward and forward motion. The grain passes over the screens; all the chaff and foreign matter is sifted through and carried away by a suction fan, and blown either out into the open or into a cyclone dust collector which separates the fine from the heavy dust. The heavy dust is then transferred to the boiler house by a suction fan through pipes and fed to the furnaces.

Grain when in a moist condition will heat spontaneously and often char. It is therefore desirable to keep the grain as dry as possible

at all times. This has led to the installation of dryers in grain elevators.

The most common and best type is the stationary dryer. The grain rests on horizontal shelves, and cold air is drawn over steam pipes and heated. The hot air is then blown through the dryer by means of a blower, and the moisture in the grain is evaporated off. In another form of dryer of the stationary type the grain rests on steam pipes for a short period. This type of dryer is exceedingly hazardous and should never be used unless constructed entirely of metal. Dryers are usually installed in separate rooms away from the elevator proper.

Elevators are used for raising or lowering the grain from one floor to another. They consist essentially of five parts: the head, the boot, two legs and an endless belt to which

metal buckets are attached. The belts over two pulleys, one in the head and one in the boot. The head pulley is mounted on the shafting and propels the belt. The lower pulley acts only as an idler. Separating the two legs and underneath the head pulley is a strut board. If this strut board is inclined, the elevator is said to have a hopper head. This strut board should always be inclined towards the up-leg and be carried up again by the buckets.

Conveyors are used in conveying the grain horizontally from one part of the building to another, or to and from the storage tanks. The belt and screw types are in most general use today. The belt conveyor consists of an endless belt mounted on rollers inclined towards each other; the

belt thus forming a trough. This belt is from three to six feet in width. The screw conveyor consists of a long screw mounted in a metal tube. The grain is pushed along by means of the blades of the screw.

The bleacher is built of brick tile or concrete and is built separate from the elevator. A spout or conveyor enters the top of the bleacher from the bins. The grain falls between shelves which are placed diagonally underneath one another and is finally caught in a hopper at the bottom from which it is carried back into the elevator by means of a conveyor. A pipe with small perforations enters the top of the bleacher, and the grain is sprayed with water in order to moisten it.

Sulphur is burned in an ordinary brick

oven, and the sulphur fumes together with steam enter the bottom of the bleacher and pass up through the grain and out through an opening at the top into the air.

Clipping machines are used for removing the hull from the grain. The interior of the machine casing is covered with numerous small points. A large steel cylinder to which beaters are attached, is so mounted that a small space is left between it and the wall of the casing. The grain passes between the rapidly moving cylinder and the casing proper where it is packed and rolled, thus removing the hull. The beaters have a screw-like action which carries the grain from one end of the machine to the other. The hull is then drawn off by a suction fan whence it is carried to a cyclone.

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PART II.

HAZARDS: The features of construction of the various types of elevators found in and aronnd Cook County vary quite considerably. The fire-proof type has concrete walls, cement-floors and bins resting on concrete columns, with no cribbing. The elevators of the type of the elevators had walls of plain brick or stone, cement floors, and bins cribbed on wooden posts and stone piers. The smaller frame houses are found frequently and their type of construction is well known.

The chief hazards as found in the majority of the elevators will first be enumerated in order of their importance without any attending discussion.

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SPECIAL HAZARDS:

Bearings - hot.

Bleacher - location; construction.

Dust hazard - separators; smutters and clippers; cyclones.

Elevators - construction; friction heads.

Grain-Dryers - location; construction and how heated.

Shafting - alighment.

Woodwork around bearings.

Dusty premises.

Exposure.

COMMON HAZARDS:

Open lights.

Power house; location and arrangement.

Oily waste; sweepings.

Electric motors.

Electric wiring.

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One hazard which was found quite frequently in the older grain house, but which is eliminated in most of the modern ones is that of the <u>friction elevator head.</u> Since the friction head in an elevator belt is a positive power it cannot stop unless the shafting is thrown out of gear, and consequently, when a stoppage was caused by any clogging, considerable friction developed. This friction has been shown to cause sufficient sparks to ignite combustible materials in elevators and thus cause fire.

The small pulley at the head of the elevator which in most elevators is an iron pulley, logged with rubber belting or composition, has great pulling power and seldom fails to pull the buckets. However, in the

old type of elevator is found the iron pulley without the logging. This has not as strong a pulling power, and it will allow the belt to stop. With this pulley type, if slight additional weight will cause the belt to stop with pulley continuing its revolutions and the belt stopped, a situation is created whereby the belt soon burns thru and each side drops back into an elevator leg, together with fire and sparks thus causing grave hazard of starting a fire, both at the top and bottom of the elevator proper.

While discussing the hazards of the elevator leg and boot, it might be stated that the inclined struts or hoppers (self cleaning) are superior to the horizontal strut boards located under the pulley and connecting legs. This is because the horizontal struts

soon become encrusted with drippings of oil from the bearings of shaftings, and also becomes loaded with grain and dust dropping from buckets. This creates a very undesirable hazard and should be avoided by using an inclined strut, mentioned above.

The dust hazard in an elevator is one that comes in for considerable discussion. It is generally understood that dust in a comparatively settled state is not dangerous. However, when dust is mixed in the air in proper proportions, it is very explosive and the necessity of avoiding chance sparks of any kind is made more apparent. One feature of the dust-explosion hazard is that one explosion may call for

another, that is, the dust settles in great quantities on all bins, chutes, and other similar parts of construction at all times. Consequently, an explosion of any size always shakes up a new amount of dust in other parts which makes another explosion possible. It has been shown conclusively that old dust undergoes a chemical change from which it acquires more explosive properties than that possessed by new dust. This fact should impress on elevator-men the necessity of proper methods of dust disposal.

Following the discussion of the dust hazard the question of the causes of ignition of the dust naturally follows. In the main, this relates to machinery hazard, hot bearings, Journal hazard and exposure.

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GRAIN DRYERS.

The general form of dryers found are direct-heated rotaries, steam heated rotaries, and stationary dryers heated by steam coils. Direct heated rotaries are no longer commonly used on account of their hazard, which hazard is self evident. Steam heated rotary types involve only the steam hazard, which is generally slight.

The commonest type of grain dryers used in elevators is the stationary type. In it are arranged steam pipes upon which the grain rests temporarily.

This type unless constructed throughout of incombustible materials, is very hazardous and should be arranged to be as accessible as possible.

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Another stationary type of dryer found is one in which the grain is at rest while hot air from steam coils is blown thru it. The hazards of grain dryers vary greatly according to type and arrangement but as a whole they are inherent hazards, being impossible of elimination.

The use of blowers may increase the hazard of the dryers in many ways, such as hot bearing hazard, dust disturbing affect, and on account of hot air being forced around the elevator. A power hazard incidental to the drying operation is also introduced.

GRAIN BLEACHERS.

The ordinary grain bleacher is not especially hazardous, unless the sulphur

burning furnace is located too near combustible materials. It is claimed that best results from bleachers are obtained when the fumes do not enter the bleacher too hot, so that if this economy is followed there will be no serious hazard if sufficient space to elevator is maintained.

SPONTANEOUS COMBUSTION.

It has been shown that a considerable spontaneous combustion hazard exists in grain-handling and working plants, and too great care cannot be exercised in connection with the storage of raw materials and finished products and the prevention of dust accumalations. Green or improperly dried grain subjected to pressure, dampened feed-stock,

The Hazards of Grain Elevators. screeings and grain dust, milled with oil bearings, have been shown to produce sufficient internal heat to ignite spontaneously.

CONVEYOR HAZARDS.

The hazards connected with the operation of conveyors are small. The main ones are over-heated bearings in the rollers, the stirring up of dust, and friction heat developed by stoppage of conveyor belts.

CYCLONE DUST COLLECTORS.

The only hazard present is the fact that if the machine is arranged to discharge into the boiler room, a spark may be drawn back into the cyclone by back pressure and thus back into the machines, where they

may smoulder for hours before breaking into a flame.

SHAFTINGS AND BEARINGS.

True alignment accessibility of oil cups and other good precautions reduce the hazards of the shafting and bearings considerably. In our inspections we found many neglected shaftings, bearings, and Journals. This created an unnecessary hazard.

SEPARATORS.

The hazards of separators are neglible except for the fact that small pieces of metal may cause sparks by contact against the separator. The same is true of Smutters, Purifiers, Aspirators and Roller-mills.

SHAFTING MACHINES.

The only hazard connected to the sifting

machine is the bearing hazard.

Another hazard which is not generally considered is that one of having openings on the side of the elevator towards the railroad. Such openings render it possible for sparks from the passing locomotives to enter the house. From a perusal of "Typical Fires" this condition has caused several severe fires.

OILY WASTE HAZARD.

The hazard from this is over estimated in elevators. While a large amount of oily waste is used, the lubricating oils are not seriously subject to spontaneous combustion. Oils are adulterated, however, and waste cans should be provided as a precautionary measure.

EXPOSURE.

The hazard of exposure is the same as that

of any other mercantile house, except for the fact that elevators are generally public nuisance and for that, and other reasons, such as transportations problems, is generally isolated. Exposures of buildings that may emit sparks should be avoided.

THE COMMON HAZARDS.

The hazards of open lights, in grain elevators are too well known for discussion; and, also the hazards of lanterns. It has been found that electric conduit system is the least hazardous method of lightning. But, the light hazard presents the same old ones that are ever present wherein explosions are liable to occur.

For heating, steam is preferred and offers little chance of hazard, if the

ordinary precaution of keeping the pipes away from wood work, waste, and other combustible material is observed. It is safe to have the pipes well insulated with an asbestos material wherever the pipe touches construction units. The use of stoves presents a great hazard, and should not be tolerated in a grain elevator. The heating question, however, is not of paramount importance as most elevators have no heating arrangement outside of the office. The power house, blacksmith, and carpenter shop hazards need no comment in connection with hazards special to grain elevators.

The following is a list of caused of fires in grain elevators, published by the Millers' National Insurance Company, and covers a considerable number of fires over a ten year period.

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	Number of fires.	Per cent of whole.
Lightning -	1	0.6
Heating -	12	7.3
Overheated stoves.	12	
Power.	18	11.0
Hot box or friction.	16	
Gas engine exhaust.	2	
Boiler.	15	9.2
Smoking.	2	1.2
Sparks from locomotives.	21	12.9
Miscellaneous.	7	4.3
Lightning.	72	44.2

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SPECIAL HAZARDS.		Per cent of whole.
Conveyors (elevator head and boot)		
Number of fires	7	4.3
Spontaneous combustion		
Number of fires	4	2.5
Dust Explosions		
Number of fires	1	0.6
Corn Cleaners		
Number of fires	1	0.6
Grain Dryer		
Number of fires	1	0.6
Sparks from Cob Pit		
Number of fires	1	0.6
T O T A L:	15	

RESUME.

Incendiary	17
Exposure	33
Unknown	137
Common hazards	148
Special hazards	15
T O T A L:	350

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PROTECTION :

Probably the most important part in considering protection and methods of protecting of a grain mill is the management. It is the management that provides the methods of work, supervises the men and if careful,keeps in close touch with everything connected with the mill. Perhaps no class of risk affords a better opportunity to display one's ability for administering affairs so as to reduce the fire hazards. Intelligent care should at all times be observed, and the watchword throughout the plant should be, Safety First.

In the majority of grain mills it is found that they are poorly provided with both

inside and outside protection. The larger mills, of course, are generally equipped with as much inside protection apparatus as is practicable, but the majority are of the country type and usually they are very poorly protected. The usual grain mills of three or four stories, frequently of frame construction, and with a one story frame or brick boiler house adjoining, are very bad risks. The open stairway running from bottom to top of the mill, the many vertical openings due to spouting; elevator legs; and belt holes; the dust-covered walls and ceilings; with liability to dust explosions; and the presence of air drafts through the large unbroken floor areas, all

contribute largely in this direction. The general conditions of operation make fire a constant menace and, the great inflammability of most mills, because of inferior construction, makes a fire, once started, so destructive that the usual methods for guarding against it have failed dismally.

The main reasons why grain mills burn are: first, many internal hazards; second, high combustibility, because of the large percentage of frame construction and, interior conditions conductive to a rapid spread of flames; third, inadequate protection; fourth, moral hazards. The internal hazards, both common and special, are always considerable in all milling risks, and these are usually poorly guarded. Once the mill is afire, because of dust covered walls,

The Hazards of Grain Elevators. combustibility of contents and poor construction, usually frame, it generally makes a quick burning fire and a total loss. The inside protection of grain mills is usually inferior and the outside protection depends wholly on their situations in regard to cities and towns and their fire fighting facilities.

From a study of grain mill fire records, it would appear as though the most special hazards to be found in grain mills are spontaneous combustion, cleaning machinery, Journals and elevators.

At the best, a mill is found to be a dirty place, and unless the management exercises great care in keeping the mill swept down, the bearings well oiled and free from dust, a grave additional hazard will be engendered. In large mills it would be advisable

for one man or more to be steadily employed oiling and cleaning bearings, sweeping, taking care of all fire appliances and acting as a general caretaker. The wages of this man should prove and be considered good investment by the owner.

Because of the dust explosion and spontaneous combustion hazards which exist in the grain mills, dust and dirt should not be allowed to accumulate; machinery should not be crowded together; "no smoking" signs should be posted; bearings should be given the best of care and attention; fire appliances should be well maintained and self closing waste cans should be provided wherein oily waste is used.

As has been said in previous discussion, the dust hazard is very great; a dust explosion

might wreck the whole mill and it's fine appliances at the same time causing a total loss. To reduce this hazard to a minimum dust collectors are usually and should always be provided. These are two general types of dust collectors used in grain mills and elevators, the tubular and the cyclone. The most commonly used is the tubular for flour mills and the cyclone for elevators.

The dust collector of the tubular type may be found in two forms; viz., stationary or, upright and revolving. The revolving tubular dust collector is the one usually found in flour mills. It consists of a cylinder with inner and outer ribs, around which flannel is wound from one piece, so that when complete there is an air-space, the

width of each rib between flannel surfaces. The dust laden air is drawn into the machine by suction and out through the cloth leaving the dust behind. The cylinder is revolved slowly, rib by rib, by a ratchet and as each rib reaches a point directly over the center of the bottom of the collector, it is tapped lightly by a Knocker, which causes the dust to drop into a conveyor which carries it away from the machine. To facilitate the removal of the dust, a back draft or reverse current of air is applied to that portion of the cloth being cleaned. Some revolving collectors instead of using Knockers to shake the dust loose from the cloth, employ a rotating cleaner, made of leather whippers or fingers, which move in and out the spaces between the filtering pockets or

ribs. The stationary tubular dust collector is generally suspended from the ceiling and operated on the same principle as the revolving tubular, the cloth tubes being cleaned either by means of a Knocker or a traveling frame with cross strips running in either direction between the rows of tubes.

The cyclone dust collector is composed of a conical casing with a dust outlet below and an air outlet above. The dust laden air is blown into the collector where it moves about in a vertical whirl, deflectors placed at certain angles overcoming a back pressure. The dust being heavier than air, falls to the bottom of the cone while the air exhausts out through the top of the collector. Sometimes in large

The Hazards of Grain Elevators. grain elevators dust collecting system is installed to collect dust from the cleaning machines, the cyclone being placed on the top of the boiler house with a discharge leading to the boilers. This kind of an arrangement is hazardous at all times, even when provided with a swing damper cut-off, for when the fan stops, sparks might be drawn by a back pressure into the cyclone and through the pipes throughout the whole plant, where they may smoulder for hours before bursting into a flame.

Dust collectors are attached to cleaning machines; purifiers and sometimes to suctions from rolls and elevators. The dust from collectors connected to grain cleaners is

usually discharged into the feed bins, but sometimes cyclone dust collectors gather the dust from the receiving separators and discharge it into the boilers as said before. The dust from collectors attached to purifiers is usually redressed and passed to low grade flour bins.

From fire underwriter investigation it has been shown that a large number of grain elevator fires are caused by over-heated bearings. These bearings, located as they are, mainly along lines of shafting, are unquestionably subject to overheating, sometimes chronically so, by reason of the shafting being thrown out of alignment, caused by the variation in the enormous

weights in the different parts of the elevator structures when the bins are filled or occupied. There are also many Journals located where it is difficult and sometimes impossible for an oiler to reach them when the machinery is running, and there are other Journals such as elevator boot Journals, which can only be oiled through long pipes which sooner or later become clogged with dust, allowing little or no oil to reach the bearings.

Even the best of care cannot prevent the bearings particularly the elevator boots, from becoming covered at times with fine grain dust, saturated with lubricating oil. The danger from this condition is apparent, the oil-saturated grain dust supplying just so

much highly inflammable material for fuel, after the bearings become heated beyond the danger point; and it is astonishing how many Journals are chronically hot and yet escape notice. One of the first results of the installation of an approved Journal Alarm System in an elevator is the discovery of chronically hot bearings, never before suspected of being in any way dangerous or out of condition. A hot Journal may not necessarily mean a fire, but it certainly invites one; and, a hot Journal furthermore, means a failure to secure the maximum efficiency in the running gear of the plant. An approved Journal alarm system not only removes one of the most fruitful sources of

fires but, also increases the efficiency of all running gears and reduces the insurance cost.

The installation consists of a thermstat on every bearing in the elevator set to give an alarm at 160 degrees Fahrenheit. These thermostats are connected with the electric wires run in moulding conduit and pipe in such a manner that it will not become injured in any way by the working of the elevator, and in no way interfere with the general care of the bearings. The wires are connected with an annunciator in the engine room which shows the engineer what floor or circuit the hotbox is on, and also connected with signal bells that are located so they can be heard on each floor throughout the elevator, and ring simultaneously the

number the hot box is on.

In each circuit there is a series of switches so that the heated box canbe located at once by the oiler. In connection with the wiring, there is an automatic testing apparatus located in the engine room which automatically tests and makes a record of every inch of wire oonnected with the system. If there should be broken wire or any other trouble with the system, it will be shown and located by the above test. Some systems are used in duplicate so that a broken wire does not stop the ringing in of the alarms but, will be shown at once and located by the automatic test. The underwriter ruling on installation of thermostats is that the

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thermostats must be on every bearing throughout the grain elevators, exceptions being made by consent of the underwriter leaving jurisdiction. As a general rule, they do not ask for thermostats on the following bearings: hanging tension idlers; trippers; concentrating rolls for belt conveyors; hanging bearings in screw conveyors. All end bearings on belt and screw conveyors have to be equipped.

These automatic Journal alarm systems are valuable factors in preventing of fires, when properly installed but the whole system must be kept in strict order and in operative condition.

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If a condition of false security exists and then the mill is considered less protected than without the alarm system entirely.

A careless oiler, who has Journals which are continually running hot will, to avoid being reprimanded for neglect of duty, often cut wires or substitute a dummy thermos or thermos of high degree and even remove thermos. This may be done without any alarm or tamper signal being given. A system which would give an alarm at any such tampering would be a decided improvement.

Journals of all types including elevator boots should be oiled directly when practicable. This would eliminate the oiling pipe or tubing as much as possible and decrease the possibility of a scarcity of oil in the Journals especially

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in cold weather, when oil is liable to freezing and clogging the pipes. To thaw out these pipes when clogged, a small red hot wire is brought from the boiler room into the elevator and forced down the tube. This practice is very hazardous and should be stopped.

It is advisable that the man who oils the machinery on the shaft or top floor should remain on this floor at all times when the machinery is running, especially so in elevators using friction heads. Every man in the mill should be on the alert, watching for any false operations. Barrels of water to be distributed throughout the plant at intervals of about 50 feet supplemented by non freezing fire extinguishers to reach high places, such as

elevator head, shafting, tighteners, idlers, etc., where a pail of water cannot be thrown with any degree of accuracy when especially in high ceilings.

The unsatisfactory features of fire extinguishers has been that they must be protected from frost due to low temperatures prevailing in elevators during cold weather. There are non-freezing types on the market which contain a solution of calcium chloride in water lowering the freezing to point as low as forty degrees below zero Fahrenheit. The expelling force is liquid carbonic acid gas contained in a steel bottle, released by puncturing a seal in the head

of the bottle. The cask and pail installation is sometimes classed as the Miller's greatest protection against fire, and nearly all mills have them and on the whole, they are well maintained.

All electrical circuits shall be in conduit and their respective cutouts or fuses should be of the plug or cartridge type and enclosed in metal dust proof cabinets, with self closing doors. This will reduce the danger of molten fuse wire being blown into rooms with dust or falling on the dusty floor or among other combustibles.

The electric motors should be either of the induction type or enclosed type and located on incombustible bases, because

of the oil leakage from the bearings which would easily be ignited by a spark from the commutator. All electric light wires should be secure except extensions for bins which should be given the best of care and inspected frequently. The electric lights should all be enclosed in outer globes.

Practically, standpipe systems in grain elevators are nearly useless. No doubt they look protective and some millers favor them but, even when properly installed and maintained, they are of little value. The standpipe in grain elevators is an indirect method i. e., one man cannot handle the system alone, because the standpipes themselves due to low temperature, must be dry, with valves, mains or pumps

in the boiler room etc.

In this condition, the standpipe system is being set into operative condition, the fire is gaining headway so as to drive out the man or man about to hold hose. The hose is usually neglected and liable to burst as soon as pressure is applied. They usually require more than one man for the play pipe work and, employes seldom risk their lives to save the property in this manner.

The installation of automatic sprinkling equipments in grain mills is frequent, it being the tendency to install sprinklers in larger mills. The great value of sprinklers in use in general special hazard risk is reduced in the grain mill. The nature

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of the occupancy and construction place them at a great disadvantage. The many vertical openings due to spouting, elevator legs, belt holes, passenger belt elevators, stairways, can be but fairly protected at best. The high combustibility of mills because of inferior construction; dust covered walls; machinery in concealed spaces; oil-soaked woodwork under and about the bearings; the presence of air draughts and large floor areas; and then the temperature condition in winter, requiring a dry pipe system, ever present conditions which seem to render installation impossible and also which tend to spread fire instantaneously through the building, thus opening sufficient sprinkler heads, sometimes where not needed, to drain

supply before accomplishing good results, even when probable dust explosions do not entirely or partly injure the system.

The chances of fire to get a good start and to spread rapidly are so great that automatic sprinklers are placed somewhat differently from the method in the ordinary factory building. The heads below the ceiling are spaced according to the usual standard, though frequently a little closer together. Around the elevators they are spaced as closely as they can be put without interfering with each other. They are also placed as near as possible to the elevator legs which act in case of fire as veritable flues. To offset this, a sprinkler head is placed at the top of

the elevator head inside the hood and the entire volume of water would be discharged down the elevator leg.

Now a fire is most liable to occur in an elevator, at the head by the burning through of the belt caused by the rotating pulley in contact with the stationary belt, when clogged. When the head opens the burning belt has dropped to the bottom of the legs setting fire to the splintered sides, due to chafing of buckets. This gives a fire about 75 feet high and the legs are usually not air-tight and entirely unprotected. By the time you have water from your dry pipe system the leg is a raging furnace and in all probability, will burst through the confining one inch partition and spread

throughout the cupola, creating drafts and in a short time be beyond control. It is therefore, wise to thoroughly equip the cupola if for this reason only and the best protection for a cupola is this because of the height from the ground, a place not appealing to an employe to fight a fire and again because fire fighting from the ground is impossible.

Sprinklers are placed at the top of the elevator shaft to protect the machinery; while, the number of nooks, crannies and other out of the way places in such a building, all have to be adequately protected. The protection of the storage bins in the elevator section of the plant is a problem in itself. In cases where the bins are subdivided at various floors, the same ceiling should be adopted as in the mill

building itself. In some installations, particularly where the storage is arranged in the form of silos, additional heads are placed beneath the floors of the silos, as well as in the space between the walls and the sides of the silos.

A considerable percentage of unsatisfactory sprinkler fires were made unsatisfactory by vertical openings or faulty construction. The maximum sprinkler efficiency cannot be expected where automatic sprinklers are at a disadvantage with regard to water distribution or rapid spread of fire, such as is produced by vertical openings, flimsy construction or concealed spaces, sheathed with wood, All of these

elements tend to spread fire rapidly and should be avoided in every case possible.

With automatic sprinkler protection, any flour mill can be rendered safe against the onslaughts of the ordinary fire, provided the installation is standard and kept in operative condition. As has been previously noted, however, there are so many unusual hazards in flour mills that some special precaution should be taken to protect the sprinkler system itself as far as may be possible. The dust collectors should be of the modern self cleaning types; while all the wind trunking to the dust collectors should be of galvanized iron. The housing for elevator heads and boots should be of metal instead of wood. These structural

improvements would insure the best working of the equipment, and the combination would tremendously lessen the hazard.

There is no better class of protection devised for fire fighting apparatus where it is granted that human agency cannot be depended upon to fight fire. The common fallacy in regard to sprinklers is in case of fire every sprinkler head in the installation opens and discharges large quantities of water, with the result that the whole building (with it's contents) is deluged and great damage done even in parts of building remote from the outbreaks. This, of course, would make their value illusory. But, a sprinkler opens through heat, and therefore only discharges water where there is actual fire or in the vicinity thereof.

This being so, it stands to reason that a sprinkler installation must, in the nature of things, create less water-damage than any fire fighting apparatus, the use and operation of which are dependent on human agency.

The metal-cladding on the outside of frame structures should be maintained in good condition and screens of small mesh of galvanized iron should be placed on all windows exposed by buildings or by smoke stacks or locomotives or boats because of the flying brand and spark hazard involved.

Watchmen if employed, should be well qualified because of their great responsibility. They should be able to speak and understand the English language, know the purpose and operation of all fire fighting apparatus provided, be acquainted with methods

of sending in fire alarms and be thoroughly familiar with the premises.

He should be intelligent with a mechanic's experience and able to do more than hobble about pulling boxes on his routine rounds. The usual watchmen are very poor due to low remuneration but, it would be much wiser to spend a little more for a good man, whose duties shall be to thoroughly examine and check up on all bearings, elevator heads and both and also this examination not only be insisted upon, but also be rechecked by others so that no mistake be made. He should have to make his rounds hourly and sufficient time given to do his routine work. More attention should be paid to watchman service and to central office reports.

The installation ofthermometer systems

The Hazards of Grain Elevators.

in storage tanks or bins given the operator the temperature or changes within the grain. He then knows at all times the condition of the grain stored in each bin for if there is any heating or possible combustion it is detected instantly by observing the reading instrument. These systems are usually for use in knowing condition of grain and whether or not it needs turning but can be also used to detect a near combustion.

After all, protective devices have been installed, there still remains the fact that they must be operative and treated with care. The fire never starts until something is not in proper order; this is brought

about by careful inspections of the employes and by the supervisors of the mills. If, though, a fire does start it should be checked at once or very soon it will be beyond control and a beautfil fire is seen.

F I N I S.